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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 289 000 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **25.08.93**

(51) Int. Cl.5: **H05B 6/68**, F24C 7/02, F24C 7/08

(21) Application number: **88106758.1**

(22) Date of filing: **27.04.88**

(54) **Automatic heating apparatus.**

(30) Priority: **30.04.87 JP 106631/87**
20.07.87 JP 180466/87

(43) Date of publication of application:
02.11.88 Bulletin 88/44

(45) Publication of the grant of the patent:
25.08.93 Bulletin 93/34

(84) Designated Contracting States:
DE FR GB IT SE

(56) References cited:
EP-A- 0 166 997
US-A- 4 336 433
US-A- 4 590 350
US-E- 31 094

(73) Proprietor: **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
1006, Oaza Kadoma
Kadoma-shi, Osaka-fu, 571(JP)

(72) Inventor: **Kasai, Isao**
1-18-205, Nishimachi Tsurumai
Nara-shi Nara-ken(JP)

(74) Representative: **Eisenführ, Speiser & Partner**
Martinistrasse 24
D-28195 Bremen (DE)

EP 0 289 000 B1

Description

The invention relates to a method of automatic control of heating an object to be heated in an automatic heating apparatus comprising a control section for controlling a heating means, a first sensor for detecting the weight of said object and a second sensor for detecting gas or steam generated by said object.

From US-A-45 90 350 it is known to provide a substantially automatic control of the heating of an object to be heated in a microwave oven, by using a weight sensor for measuring the weight of the object to be heated in order to calculate the necessary heating time from this measured weight, and a gas or steam sensor for detecting gas or steam generated by the heated object. The measuring values of both sensors are either used separately or together to stop the heating operation of the microwave oven after the calculated heating time and/or after the development of a certain gas or steam level. It is commonly known that cold (but not frozen) products can be heated evenly and properly by a continuous microwave heating operation, whereas frozen products need to be heated by a different, intermittent microwave heating operation, because otherwise the frozen products would not be heated evenly throughout its volume, namely the centre region would remain rather cool. Accordingly, it was not only necessary to distinguish between different kinds of food by operating different select keys, but in addition a selection had to be made manually by operating either a reheat key (for cold but not frozen products) or a defrost/reheat key (for frozen products).

It is an object of the present invention to properly select heating sequences for reheating cold (but not frozen) products on the one hand and frozen products on the other hand without the necessity to select between two different reheating programs.

This object is solved by a method of automatic control in an automatic heating apparatus which is characterized by the control section of the apparatus performing the following steps:

a) measuring, by the first sensor, the weight of the object placed in the heating apparatus;

b) calculating an identification time period for judging, on the basis of the measured weight of the object, the kind of the object to be heated;

c) measuring, by the second sensor, the change of the gas or steam value at the end of the identification time period;

d) comparing the measured change of the gas or steam value with a predetermined value and

e) selecting one of a plurality of heating sequences dependent on the comparison result.

Preferable modifications of the method according to the invention are defined in the dependent claims.

The invention will now be described by example with reference to the accompanying drawings in which:

Fig. 1 is a front elevational view, on an enlarged scale, of an operating panel of an automatic heating apparatus according to one preferred embodiment of the present invention;

Figs. 2(a) and 2(b) are graphs showing the relationship of the detection and control of a reheat key of the automatic heating apparatus of Fig. 1;

Figs. 3(a) and 3(b) are graphs for judging the group of the food to be reheated in the automatic heating apparatus of Fig 1;

Fig. 4 is a diagram showing the structure of the automatic heating apparatus of Fig. 1;

Fig. 5 is a circuit diagram of the apparatus of Fig. 1; and

Figs. 6 and 7 are flow-charts of the control program of the apparatus of Fig. 1.

With reference to Fig. 1, essentially showing an operating panel of the automatic heating apparatus of the present invention, various select keys 4 are arranged on the operating panel 3. It is so arranged that reheating operation is performed by depression of a single "mighty reheat" key 5. Whereas two reheat keys were provided in the prior art devices for the cold food group and the frozen food group, a single reheat key 5 is enough for both the cold food group and the frozen food group according to the present invention. The reason for this will be made clear hereinbelow.

The automatic heating apparatus of the present invention is provided with two sensors. A first sensor is a weight sensor which detects the total weight of the food (including the packing). One example of such a weight sensor is a weight sensor manufactured by the assignee of the present application, Matsushita Electric Industrial Co., Ltd., which is in the form of an air capacitor having two ceramic base plates attached with metallic films, so that the metallic films are opposite to each other through an air layer. The capacity of the capacitor is changed in accordance with the weight load. The total weight of the food to be heated is detected by the first sensor when the food is started to be heated, and a time value Tw is calculated on the basis of the detected weight. On the other hand, the second sensor is a gas sensor which detects gas or steam generated from the food.

Fig. 2 shows detection points by the gas sensor and the detection time of the food by the weight sensor, etc. Specifically, Fig. 2(a) shows the case where the cold food group is heated, and Fig. 2(b) shows the case where the frozen food group is heated. The operation common to both cases is

that the total weight of the food is detected when the food is started to be heated, and it is watched sequentially whether the amount of steam generated from the food before the time point Tw, calculated on the basis of the detected total weight of the food, has changed in the form of the signal level of the gas sensor from an initial value V by a level Δg or by a level Δh.

With a change by the level Δh observed at the time point Tw, the food to be heated is judged to be the cold food group, and the food is continuously heated as it is. On the other hand, without a change by the level Δh observed at the time point Tw, the food to be heated is determined to be the frozen food group, and the heating caloric value is switched and then the food is continuously heated. By noting the time period Tw determined by the total weight of the food, the food can be classified into the group of cold foods and the group of frozen foods, because it has been made clear from experiments that, as shown in Fig. 3(a), the cold food group displays the change in the level Δh earlier than the calculated time point $Tw = AxW + B$, while the frozen food group shows the change of the level Δh later than the time point $Tw = AxW + B$. Even when the cold food group and the frozen food group having the same weight are heated by the same heating caloric value, the initial temperature of the food is different, that is, the early temperature of the frozen food group is below the freezing point, whereas that of the cold food group is above 0 °C, and even if the cold food group is placed in a refrigerator, the early temperature thereof is about 5 °C. Consequently, an accumulative heating caloric value necessary for raising the early temperature of the food to be boiling temperature at which steam is generated from the food is different from each other, and the time period representing the difference of the accumulative heating caloric value is longer in the frozen food group than in the cold food group. In the manner as above, according to the present invention, the food to be heated can be automatically classified into the cold food group and the frozen food group in the same one heating sequence, and therefore a single select key can perform automatic reheating of various kinds of foods such as "cold boiled rice", "soup", "curry/stew", "frozen rice" or "frozen curry".

It was found by experiments that the calculation formula for identifying the food to be heated on the basis of the weight thereof can be expressed by a linear expression: $Tw = AxW + B$ wherein constant A is optimum at about 0.25 seconds/grams and constant B is optimum at about 30 seconds, with Tw being seconds and w being grams. Even when the total weight of the cold food is different by ±200 grams from that of the frozen food because of the weight difference of the packing, the identification of the food is correctly done. Therefore, by the linear expression, the food can be heated in a suitable manner.

The construction of the automatic heating apparatus of the present invention will now be described.

Referring to Fig. 4, various commands inputted through depression of the select key 4 on the operating panel 3 are read in a control section 6 to be displayed in a predetermined manner, thus controlling the progress of heating. Reference numeral 5 indicates a "reheat" key.

Food 8 to be heated is placed in a heating chamber 7 and heated by a magnetron 9 which is a high-frequency generating means. The supply of power to the magnetron 9 is controlled by the control section 6 through a driver 10. A fan 11 is provided so as to cool the magnetron 9 and at the same time ventilate the heating chamber 7. In an exhaust guide 12, for discharging the exhaust out of the apparatus, is provided a second sensor, namely, a gas sensor 13 which detects gas or steam generated from the food, thereby to give information on the heating condition to the control section 6 through a detector circuit 14.

The automatic heating apparatus of the present invention is also provided with a first sensor, i.e. a weight sensor 15 which detects the total weight of the food 8 on a platform 16. The control section 6 is formed of microcomputers. The gas sensor 13, which makes use of the fact that an electric characteristic such as the resistance value of a sensor element or capacity of a capacitor is changed as the density or the amount of the liquid component of the steam and an aromatic organic gas or an aromatic inorganic gas, etc. in the air is changed. It can be a specific humidity sensor manufactured by Matsushita Electric Industrial Co., Ltd. or Tokyo Shibaura Co., Ltd., or a gas sensor produced by Le Figaro.

Although the calculation formula for obtaining the detection time of the food by the weight sensor is a linear expression $T2 = AxW + B$ (A and B are constants) in the present embodiment, an expression of a higher degree can be used. Further, it is needless to say that the value of the level Δh is peculiar to the apparatus, and the most suitable value may be selected for each apparatus.

Fig. 5 is a circuit diagram showing the construction of the control circuit which is controlled by a microcomputer 17. A command inputted from the select key 4 to input terminals I0-I3 of the microcomputer 17 is decoded in the microcomputer 17, so as to be generated in a predetermined output. For example, when the "reheat" key is depressed, the microcomputer 17 makes such display as "A1" in a display section 18. The display section 18 is driven dynamically in order to reduce the number

of signal lines. Display data is outputted to data outputs D0-D7 and a digit control signal is outputted to digit outputs S0-S4. The digit control signal is used also for sweeping the key matrix 4. An output of the gas sensor 13 is inputted to an A/D conversion input terminal A/D of the microcomputer 17 in which the change of the resistance value as a result of the change of the steam amount is measured. Moreover, an output of the weight sensor 15 is, through a detection circuit 19, inputted to the input terminal I4 of the microcomputer 17. The detector circuit 19 is formed by an oscillation circuit, a bridge circuit, etc.

Upon starting of heating, relay control outputs R0 and R1 are outputted from the microcomputer 17 through a driver 20. A relay switch 21 controls outputting of microwave energy through intermittent operation thereof, and a relay switch 22 controls supply of electricity to the heating apparatus. The magnetron 9 serves to supply microwave energy to the heating chamber. There are also provided in the automatic heating apparatus a motor 23 for the cooling fan, etc., a light 24 inside the apparatus, a door switch 25 operated concurrently with opening or closing of the door member, and a buzzer 26 for notifying the user of the end of heating or the like.

Figs. 6 and 7 are flow-charts of the control program. First, the microcomputer 17 and the control circuit are initialized by initial setting. Then, the display decoder is controlled in the manner as explained with reference to Fig. 5. Thereafter, it is judged whether cooking is being carried out. If cooking is not being performed, a depressed key is read. When the "reheat" key is selected, with the food to be heated inside the heating chamber, and the "heating start" key is depressed, then heating is started. Simultaneously with this, the weight (Wg) and the initial humidity condition (V0 level) of the food to be heated are detected by the weight sensor and the gas sensor, respectively. Then, three heating stop time periods, TL1, TL2 and TL 3, together with an identification time period Tw for stopping heating in accordance with the condition of the food, are calculated (a). Upon start of heating, the humidity condition (V) is kept watched, and also the passed time (T) is continuously observed (b). In order to stop heating of food among the cold food group, such as cold boiled rice, that is easy to be heated and fast to generate steam in the heating stop time period TL1 calculated on the basis of the food weight, it is arranged to watch whether the amount of steam generated from the food is changed by the g level corresponding to the change of the signal level of the gas sensor. When the humidity change by the g level is noticed, with the time period TL1 passed, heating is immediately stopped (c). At this time, if either one of the above conditions is not satisfied, that is, the humidity change of the g level is not observed or the time TL1 is not passed, heating is not stopped, but it is determined whether the passed time T is the time period Tw which is obtained on the basis of the food weight (d) (1-3 levels are designated for g). When the passed time T is longer than time T2, it is compared and detected whether the food is heated so much that the steam generated from the food changes the signal level of the gas sensor by the h level, or whether the amount of the generated steam is too small to reveal the change of the h level. As a result, one of the first heating process for the cold food group and the second heating process for the frozen food group is selected for the heating sequence (e) (5-12 levels are assigned for h). In the manner as described above, the food is classified by with or without the change over the h level of the signal level of the gas sensor in comparison with the initial value in the time period Tw determined on the basis of the food weight.

According to the second heating process for the frozen food group, heating by the microwave energy is intermittently done as shown in Fig. 7(f). The humidity condition (V), the passed time (T), etc. are watched (g). It is determined whether or not the passed time (T) is beyond the heating stop time TL2 which is calculated on the basis of the food weight W (h). The value of f is so determined that there is no food which has been heated over the time TL2 and is reheated, and which generates too small of an amount of steam to bring about the change of the f level. In other words, the value of f is so set as to prevent such dangerous state that the food which is too dry or unfit for reheating is kept heating to be scorched or take fire. In the case where the signal level of the gas sensor is changed by f level, heating is continued. However, if the signal level of the gas sensor is not changed by f level, the food is regarded to be in a dangerous condition and stopped to be heated (i) (2-5 levels are selected for f). Even for heating of the frozen food group, the time when the h level change in the signal level of the gas sensor is observed as the food is heated to be warm is memorized as the first detection time point T1 (j), with an aim that when the passed time is beyond the TL3 calculated on the basis of the food weight, it can be detected either that the food is fully heated for automatic heating and cooking or that the food is in such a condition that enough of an amount of steam is not generated from the food to make the heating condition ready for automatic heating and cooking in spite of the h level change observed in the signal level of the gas sensor. If a sufficient amount of steam is not generated from the food, it is arranged to stop heating in order to prevent that the food is heated too much and scorched or takes fire (k). Thereafter, the food is

heated enough before the second detection point when the signal level of the gas sensor is α times of the initial value V0, with the generated steam filling the heating chamber (ℓ). The time period passed before the second detection point is memorized as T2. The time factor K for setting an additional heating time is calculated on the basis of the ratio of the time lag (T2-T1) between the first detection point T1 and the second detection point T2 with respect to the passed time period T2, so that the additional heating time is obtained by the produced of the passed time period T2 and the factor K (m). Thus, heating is continued for the additional heating time KxT2, to complete heating of the frozen food in the second heating process.

Although heating is carried out slowly by the intermittent supply of electromagnetic waves in the second heating process above, it goes without saying that the food to be heated can be supplied with small heat such as the heat of an electric heater or of gas combustion, thereby to realize heating of the whole frozen food in a moderate manner.

Moreover, also in the case of reheating of the cold food in the first heating process, for identifying the kind of the food to be heated, an additional heating time factor K is calculated based on the ratio of the time lag (T2-T1) between the first detection point T1 when the h level change in the signal level of the gas sensor due to the steam generated from the food is observed and the second detection point T2 when the change of the signal level of the gas sensor due to the generation of steam from the food becomes α times of the initial value V, with respect to the time period T2 passed before the second detection point. Then, the additional heating time KxT2 is obtained by the product of the calculated additional heating time factor K and the passed time T2. After heating for the additional heating time, heating is stopped at last.

Since the additional heating time KxT2 is calculated based on the time lag between the first detection point and the second detection point, which time lag is changed depending on the material and the amount of the food and the condition of the container of the food, the additional heating time KxT2 can be determined in correspondence to the condition of the food, whether it is cold food or frozen food.

The additional heating time factor K calculated on the basis of the ratio (T2-T1)/T2 reflects the condition of the food as follows. The time lag between the first detection point and the second detection point reflects the difference of the food, namely, that the food to be heated has low heat conductivity and needs a long time to be totally heated or that the food is heated fast in a short time. Further, when the food is covered with a so-called wrapping made of a transparent resinous film, time is necessary before the steam is generated from the food and gathered in the food so much as to break the wrapping after the food gets warm, and a large amount of steam is generated all at once after the wrapping is broken. Accordingly, the time lag between the first detection point and the second detection point becomes small. On the contrary, without the wrapping, the steam is gradually generated in accordance with the temperature rise of the food, and therefore the first detection point comes soon in a short heating time, resulting in a large time lag between the first detection point and the second detection point. As described above, the time lag differs depending on the fact whether the food is wrapped or not, or by the characteristic of the heat conductivity of the food, etc. Moreover, when the total weight of the food is large, the time before the generation of the steam from the whole of the food becomes long. Therefore, if only the time lag between the first detection point and the second detection point is taken into consideration, it is difficult to find what the time lag is resulted from, namely, the difference of the kind of the food, whether the food is easy to generate the steam per unit weight or the food is easy to be warmed. Because of the above fact, the time period T2 passed before the second detection point is employed for representing the total weight of the food, and the ratio of the time lag between the first detection point and the second detection point with respect to the passed time before the second detection point is calculated. Accordingly, the ratio can be regarded as a characteristic value of the food, in consideration of the material, condition, and total weight of the food.

As is made clear from the foregoing description, the automatic heating apparatus of the present invention has the following effects and merits.

(1) The automatic heating apparatus employs a gas sensor and a weight sensor, so that it is watched how much the signal level of the gas sensor is changed as compared with the initial value thereof at the start of heating in the time calculated on the basis of the weight of the food (including the packing), thereby to detect the presence of a large change of the signal level over the predetermined value. Thus, reheating can be performed by depression of a single "mighty reheat" key. Accordingly, the user of the apparatus is neither worrying nor mistaken as to which key should be selected, and therefore the operating efficiency is remarkably improved. Nevertheless, the finished menus are as good as in a conventional heating apparatus having 4-5 select keys.

(2) The poor correspondence to the weight of food of the response of the gas sensor is im-

proved by the weight sensor. Therefore, heating can be controlled to be stopped even when a small increase of the steam amount generated from the food is detected in the time calculated on the basis of the total weight of the food detected by the weight sensor, thereby to prevent overheating of such food that generates little steam.

(3) Even when the amount of the steam generated from the food is not so much as to change the signal level of the gas sensor to a predetermined level although the weight of the food is high enough, or the signal level of the gas sensor is not changed due to breakage of the gas sensor, i.e., even under particular conditions for automatic heating, it can be prevented that the precious food is overheated and scorched. Moreover, even when the apparatus is idly driven without any food placed in the heating chamber, since it is so arranged that no change is brought about in the signal level of the gas sensor corresponding to a predetermined amount before the heating time detected on the basis of the detection of the weight sensor, heating is safely stopped in quite a short time.

(4) Even when the food weight is high enough, and the signal level of the gas sensor is changed by the generated steam to a predetermined first level change, but not to a second level change, namely, even when dry food is heated or a frozen meat bun contained in a large heavy container is heated, under particular conditions for automatic heating, an accident that the food is overheated to be scorched can be prevented since it is arranged to stop heating by the time calculated on the basis of the food weight. Further, even when interferences from outside such as microwaves of the heating apparatus, discharging noises of a relay contact or induction surge noises of a transformer or a motor reach the control section during heating, and consequently normal change of the signal level of the gas sensor is not transmitted to the control section, heating is arranged to be stopped by the time calculated on the basis of the food weight, without being kept heated until the signal level of the gas sensor reaches the level at the second detection point (impossible level). Thus, the automatic heating apparatus of the present invention is safe.

As has been described hereinabove, the present invention enables operating keys to be simplified with intensive function in the heating apparatus provided with a gas sensor and a weight sensor such as an electronic oven, an electric oven, a combination oven, or a gas oven. Moreover, the heating apparatus according to the present invention is provided with a plurality of sensors so as to detect the condition of the food to be heated time by time, so that the heating time can be controlled properly to prevent overheating of the food. As a result, the heating apparatus of the present invention enjoys great improvement in safety.

Claims

1. A method of automatic control of heating an object (8) to be heated in an automatic heating apparatus comprising a control section (6) for controlling a heating means (9), a first sensor (15) for detecting the weight (W) of said object (8), a second sensor (13) for detecting gas or steam generated by said object (8);
characterized by the control section (6) performing the following steps:
   a) measuring, by the first sensor (15), the weight (W) of the object (8) placed in the heating apparatus;
   b) calculating an identification time period (Tw) for judging, on the basis of the measured weight (W) of the object (8), the kind of the object (8) to be heated;
   c) measuring, by the second sensor (13), the change of the gas or steam value (V) at the end of the identification time period (Tw);
   d) comparing the measured change of the gas or steam value (V) with a predetermined value (Δg, Δh) and
   e) selecting one of a plurality of heating sequences dependent on the comparison result.

2. A method as claimed in claim 1, wherein said second sensor (13) is a specific humidity sensor which detects the absolute humidity.

3. A method as claimed in claim 1, wherein the weight (W) of the object (8) to be heated is the total weight including the packing.

4. A method according to any of claims 1 to 3 for selecting one of two main heating sequences, particularly for heating cold food or frozen food,
characterized in that
in step d) it is decided as to whether the measured change of the gas or steam value (V) reaches the predetermined value (Δh) or not, and
that in case the predetermined value (Δh) is reached at the end of the identification time period (Tw) a heating sequence suitable for heating cold food is selected (Fig. 2a),

whereas in case the predetermined value (Δh) is not reached a heating sequence suitable for heating frozen food is selected (Fig. 2b).

5. A method as claimed in claim 4, wherein the identification time period (Tw) is calculated by an equation: $Tw = AxW + B$ (A and B are constants, and W is the weight of the object to be heated).

6. A method according to claim 5, wherein
   A = 0.25 seconds/grams
   B = 30 seconds
   (with Tw in seconds and W in grams).

Patentansprüche

1. Verfahren zur automatischen Steuerung des Erhitzens eines Gegenstandes (8) in einem automatischen Heiz- oder Kochgerät, mit einem Steuerabschnitt (6) zur Steuerung einer Heizeinrichtung (9), einem ersten Sensor (15) zum Messen des Gewichtes (W) des Gegenstandes (8), einem zweiten Sensor (13) zum Messen von durch den Gegenstand (8) erzeugten Gas oder Dampf;
   dadurch gekennzeichnet, daß
   der Steuerabschnitt (6) folgende Schritte ausführt:
   a) Messen des Gewichtes (W) des in der Heizeinrichtung liegenden Gegenstandes (8) durch den ersten Sensor (15);
   b) Berechnen eines Identifizierungszeitraums (Tw) zum Identifizieren der Art des zu erhitzenden Gegenstandes (8) auf der Basis des gemessenen Gewichtes (W);
   c) Messen einer Änderung des Gas- oder Dampfwertes (V) am Ende des Identifizierungszeitraums (Tw) durch den zweiten Sensor (13);
   d) Vergleichen der gemessenen Änderung des Gas- oder Dampfwertes (V) mit einem bestimmten Wert (Δg, Δh) und
   e) Auswählen einer aus einer Mehrzahl von Erhitzungsfolgen abhängig von dem Vergleichsergebnis.

2. Verfahren nach Anspruch 1,
   dadurch gekennzeichnet, daß der zweite Sensor (13) ein spezieller Feuchtigkeitssensor ist, der den absoluten Feuchtigkeitsgehalt mißt.

3. Verfahren nach Anspruch 1,
   dadurch gekennzeichnet, daß das Gewicht (W) des zu erhitzenden Gegenstandes (8) das Gesamtgewicht einschließlich Verpackung ist.

4. Verfahren nach einem der vorstehenden Ansprüche zur Auswahl einer aus zwei Haupt-Erhitzungsfolgen, insbesondere zum Erhitzen von kalten Nahrungsmitteln oder tiefgefrorenen Nahrungsmitteln,
   dadurch gekennzeichnet, daß
   im Schritt d) entschieden wird, ob die gemessene Änderung des Gas- oder Dampfwertes (V) den vorbestimmten Wert (Δh) erreicht oder nicht, und
   daß im Falle des Erreichens des vorbestimmten Wertes (Δh) am Ende des Identifizierungszeitraums (Tw) eine zum Erhitzen kalter Nahrungsmittel geeignete Erhitzungsfolge ausgewählt wird (Fig. 2a),
   während im Fall des Nichterreichens des vorbestimmten Wertes (Δh) eine zum Erhitzen tiefgefrorener Nahrungsmittel geeignete Erhitzungsfolge ausgewählt wird (Fig. 2b).

5. Verfahren nach Anspruch 4,
   dadurch gekennzeichnet, daß der Identifizierungszeitraum (Tw) durch die Gleichung $Tw = A \times W + B$ berechnet wird (wobei A und B Konstanten und W das Gewicht des zu erhitzenden Gegenstandes sind).

6. Verfahren nach Anspruch 5,
   dadurch gekennzeichnet, daß
   A = 0,25 Sekunden pro Gramm, und
   B = 30 Sekunden
   betragen (wobei Tw in Sekunden und W in Gramm ausgedrückt werden).

Revendications

1. Procédé de commande automatique du chauffage d'un objet (8) devant être chauffé dans un dispositif de chauffage automatique comprenant une section de commande (6) pour la commande d'un moyen de chauffage (9), un premier capteur (15) pour la détection du poids (W) dudit objet (8), un second capteur (13) pour la détection de gaz ou de vapeur généré par ledit objet (8),
   procédé caractérisé par le fait que la section de commande (6) effectue les étapes suivantes :
   a) la mesure à l'aide du premier capteur (15) du poids (W) de l'objet (8) placé dans le dispositif de chauffage;
   b) le calcul d'une période de temps d'identification (T_W) pour la détermination, sur la base du poids mesuré (W) de l'objet (8), du type de l'objet (8) à chauffer;
   c) la mesure, à l'aide du second capteur (13), de la variation de la valeur de gaz ou de vapeur (V) à la fin de la période de

temps d'identification (T_W);
d) la comparaison de la variation mesurée de la valeur de gaz ou de vapeur (V) avec une valeur prédéterminée (Δg, Δh) et
e) la sélection d'une séquence parmi une pluralité de séquences de chauffage selon le résultat de la comparaison.

2. Procédé selon la revendication 1, selon lequel ledit second capteur (13) est un capteur spécifique d'humidité détectant l'humidité absolue.

3. Procédé selon la revendication 1, selon lequel le poids (W) de l'objet (8) à chauffer est le poids total incluant l'emballage.

4. Procédé selon l'une quelconque des revendications 1 à 3, pour la sélection d'une séquence parmi deux séquence principales de chauffage, en particulier pour le chauffage d'un aliment froid ou surgelé,

procédé caractérisé en ce qu'à l'étape d), on décide si la variation mesurée de la valeur de gaz ou de vapeur (V) atteint la valeur prédéterminée (Δh) ou non et en ce que, dans le cas où la valeur prédéterminée (Δh) est atteinte à la fin de la période de temps d'identification (T_W), une séquence de chauffage adaptée au chauffage d'un aliment froid est sélectionnée (Figure 2a) tandis que, dans le cas où la valeur prédéterminée (Δh) n'est pas atteinte, une séquence de chauffage adaptée au chauffage d'un aliment surgelé est sélectionnée (Figure 2b).

5. Procédé selon la revendication 4, selon lequel la période de temps d'identification (T_W) est calculée par l'équation suivante :

$$T_W = A \times W + B$$

(A et B sont des constantes et W est le poids de l'objet à chauffer).

6. Procédé selon la revendication 5, selon lequel :

A = 0,25 seconde/gramme
B = 30 secondes
(avec T_W en secondes et W en grammes).

F I G. 1

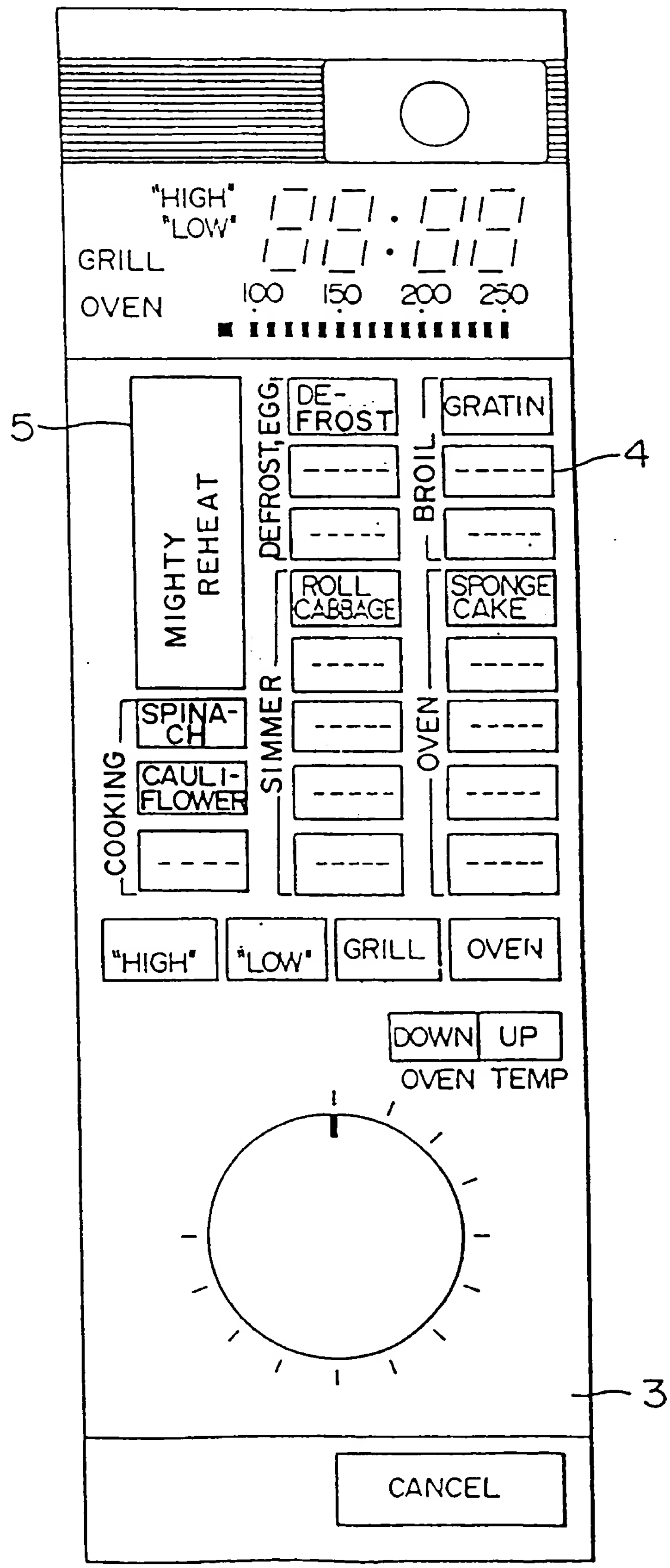

"HIGH"
"LOW"
GRILL
OVEN
100 150 200 250
5
MIGHTY REHEAT
DEFROST, EGG
DE-FROST
GRATIN
BROIL
4
ROLL CABBAGE
SPONGE CAKE
SIMMER
OVEN
SPINA-CH
CAULI-FLOWER
COOKING
"HIGH"
"LOW"
GRILL
OVEN
DOWN
UP
OVEN TEMP
3
CANCEL

Fig. 2

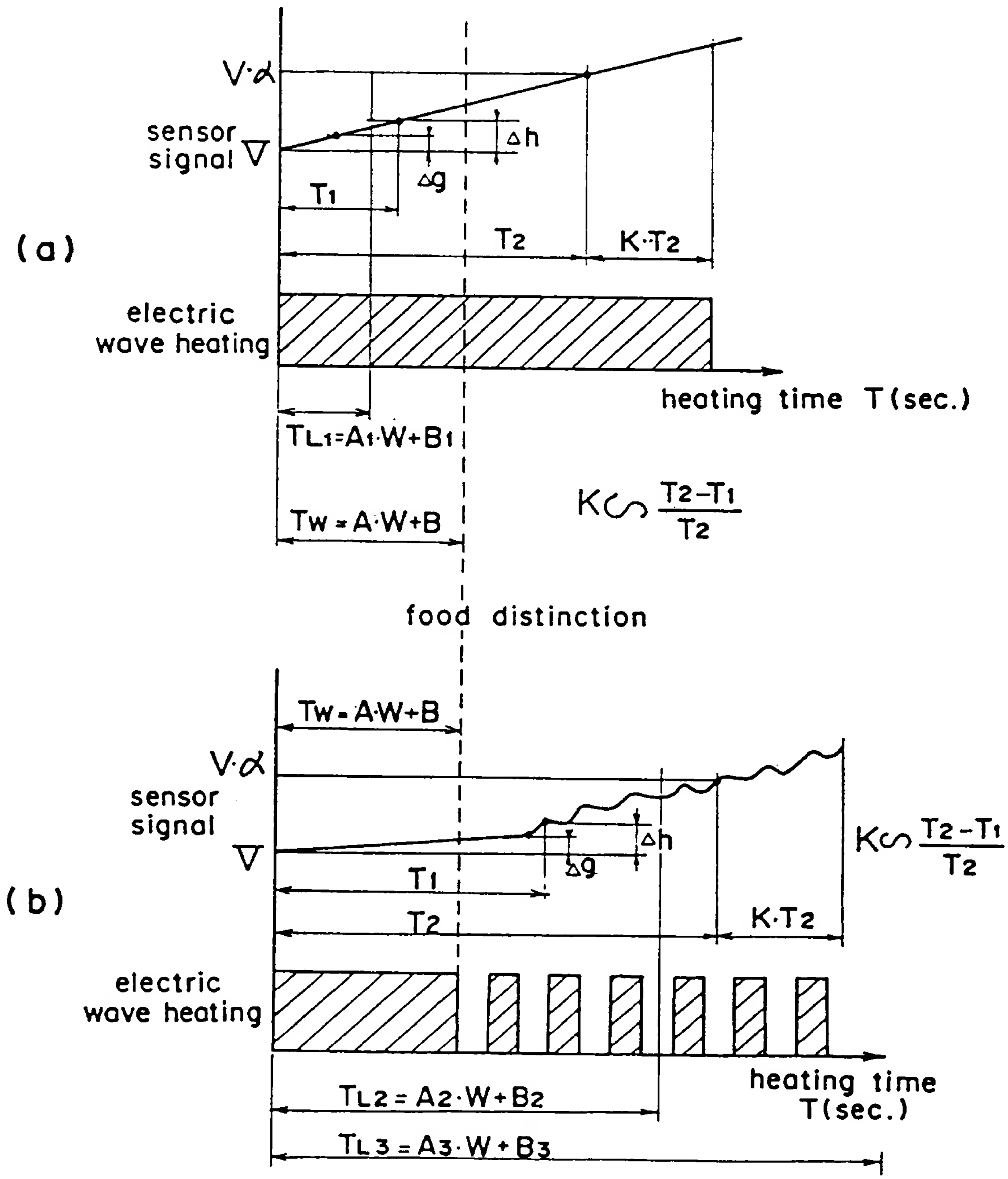

V·α
sensor signal V
Δh
Δg
T1
(a)
T2
K·T2
electric wave heating
heating time T(sec.)
TL1=A1·W+B1
Tw = A·W+B
K∽ (T2−T1)/T2
food distinction
Tw = A·W+B
V·α
sensor signal
V
Δh
Δg
T1
(b)
T2
K·T2
K∽ (T2−T1)/T2
electric wave heating
heating time T(sec.)
TL2 = A2·W+B2
TL3 = A3·W+B3

Fig. 3

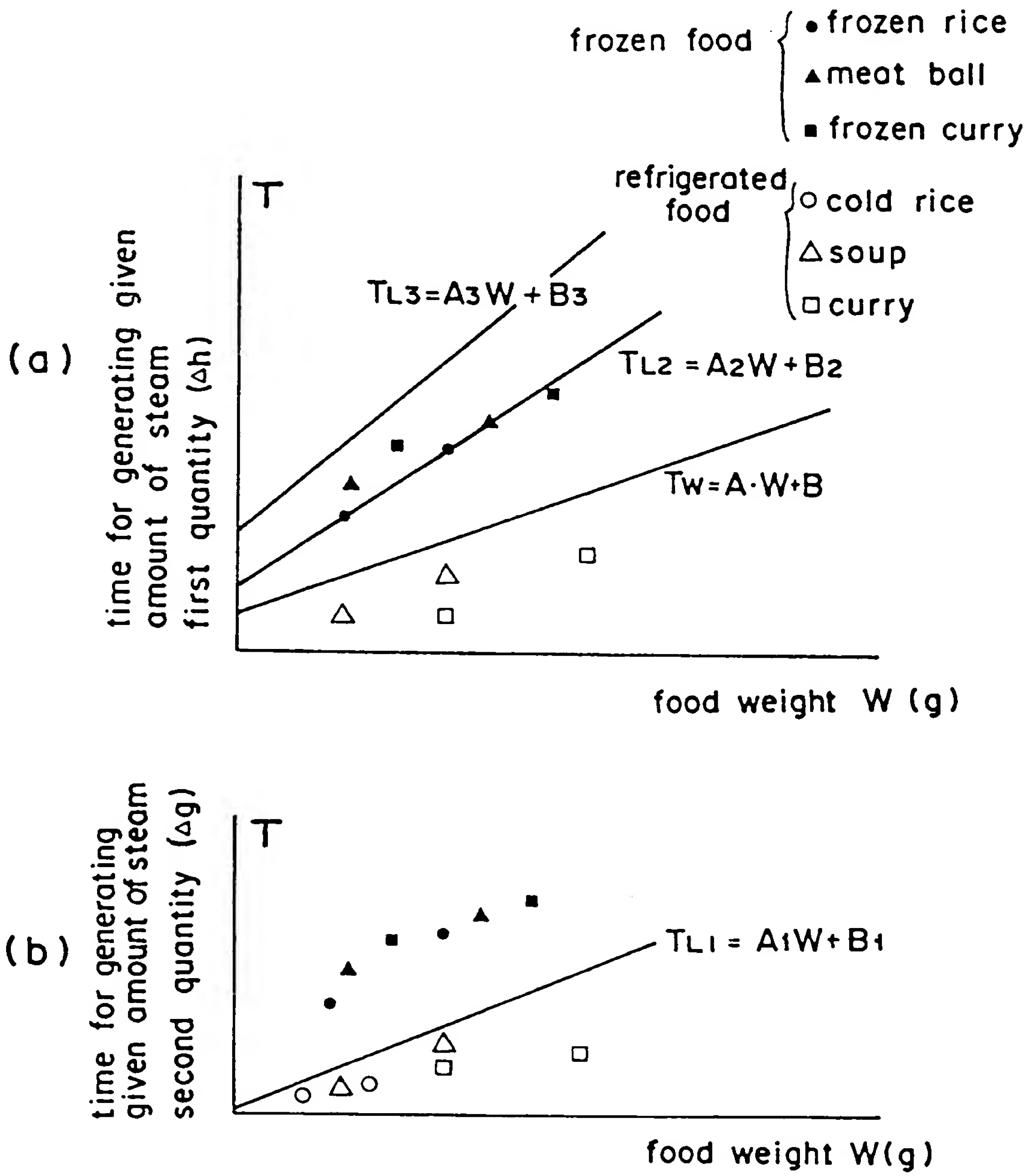

frozen food
frozen rice
meat ball
frozen curry
refrigerated food
cold rice
soup
curry
T
time for generating given amount of steam first quantity (Δh)
(a)
TL3 = A3W + B3
TL2 = A2W + B2
TW = A·W + B
food weight W (g)
(b)
T
time for generating given amount of steam second quantity (Δg)
TL1 = A1W + B1
food weight W(g)

FIG. 4

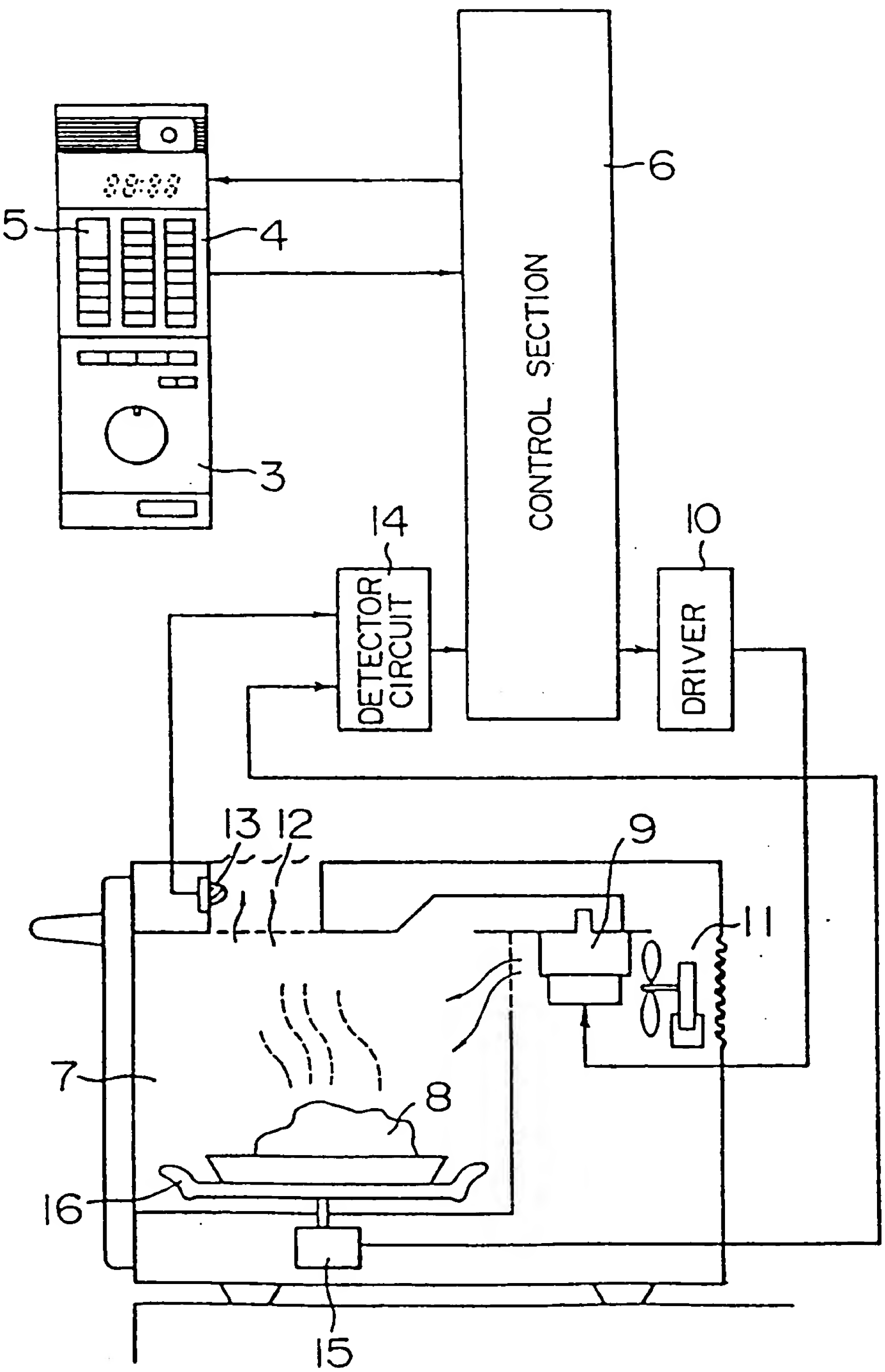

88:88
5
4
6
CONTROL SECTION
3
14
DETECTOR CIRCUIT
10
DRIVER
13
12
9
11
7
8
16
15

FIG. 5

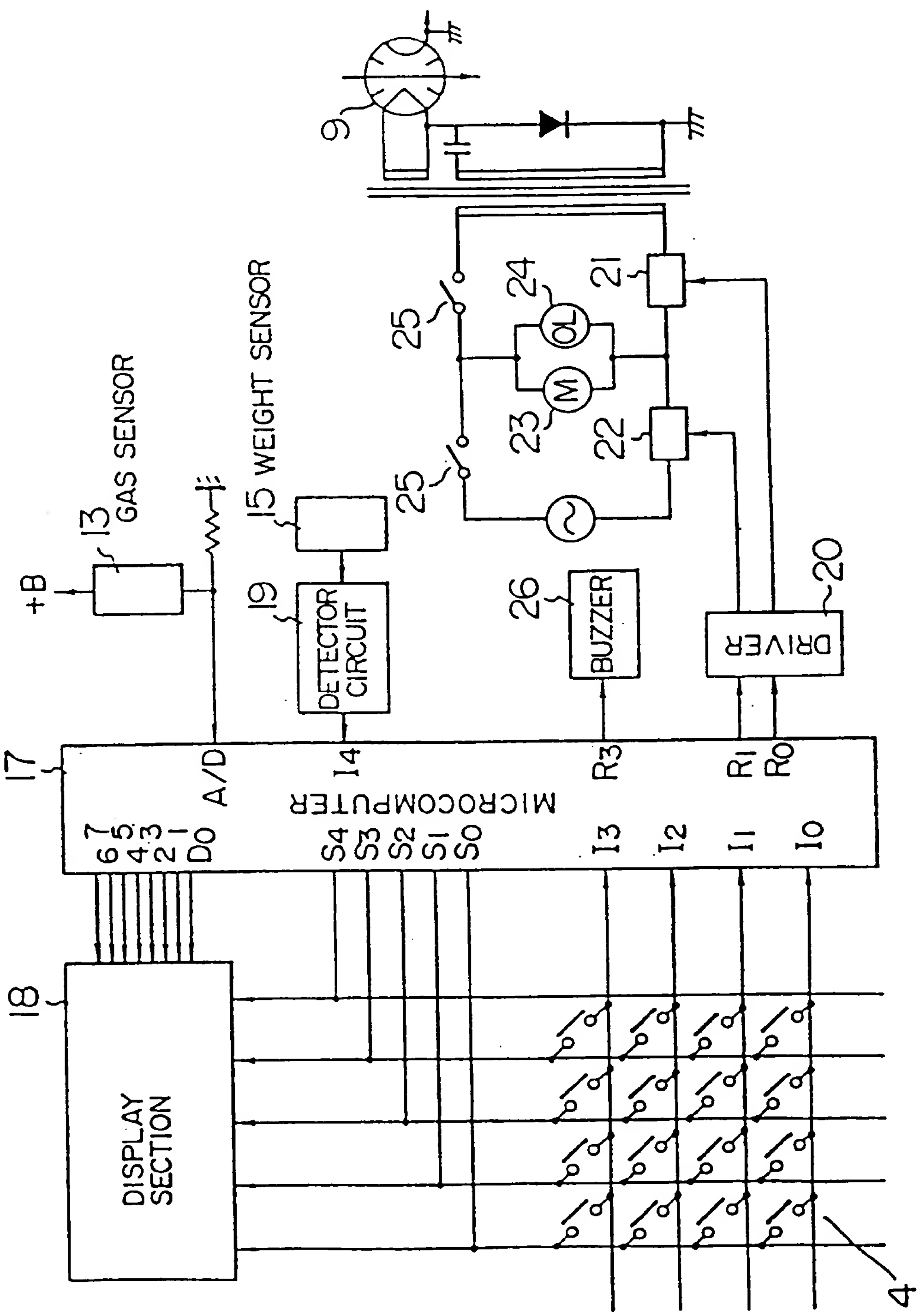

+B
13
GAS SENSOR
15 WEIGHT SENSOR
19
DETECTOR CIRCUIT
26
BUZZER
20
DRIVER
17
MICROCOMPUTER
A/D
I4
R3
R1
R0
7 6 5 4 3 2 1 D0
S4 S3 S2 S1 S0
I3 I2 I1 I0
18
DISPLAY SECTION
4
25
25
23
24
22
21
M
OL
9

Fig. 6

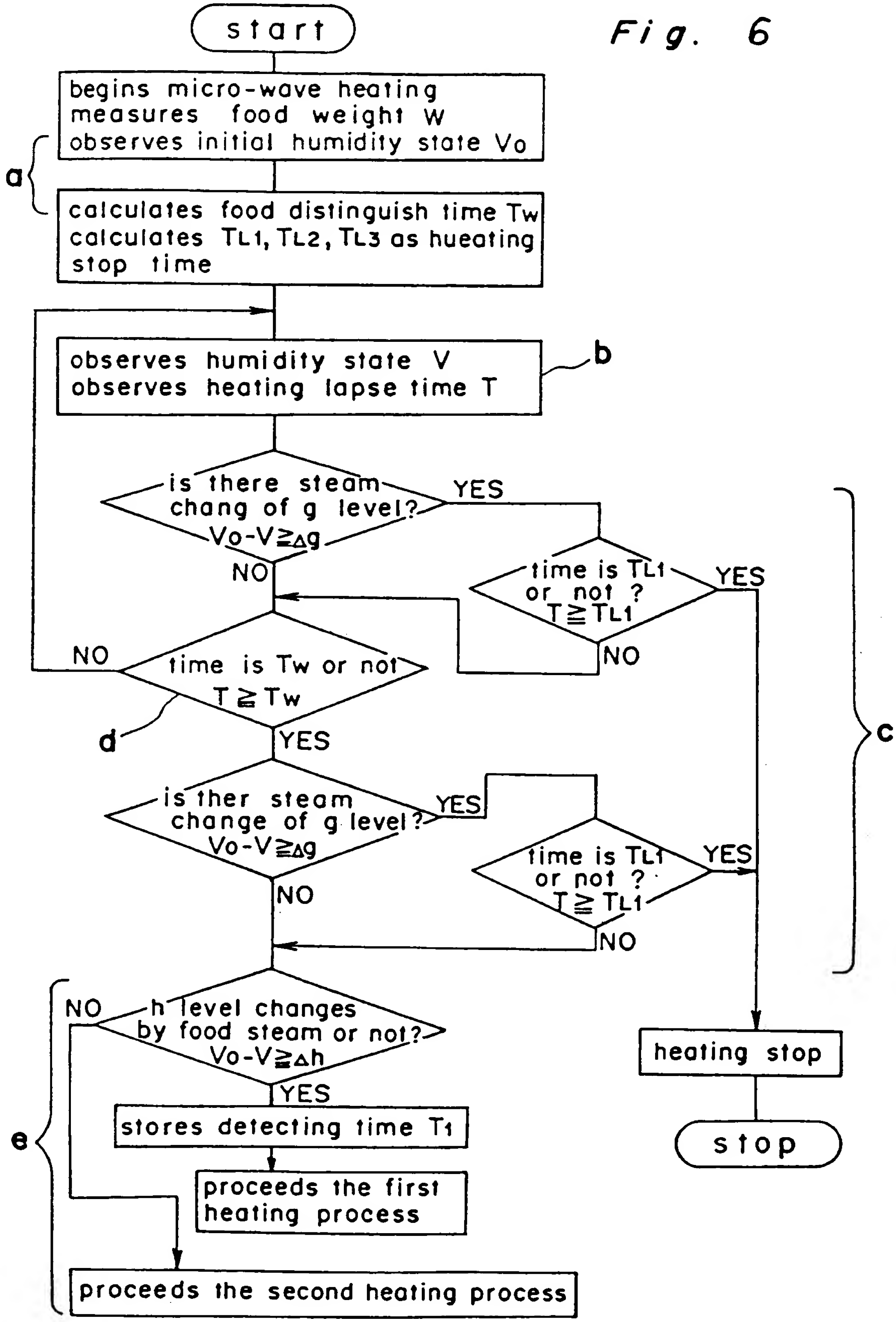
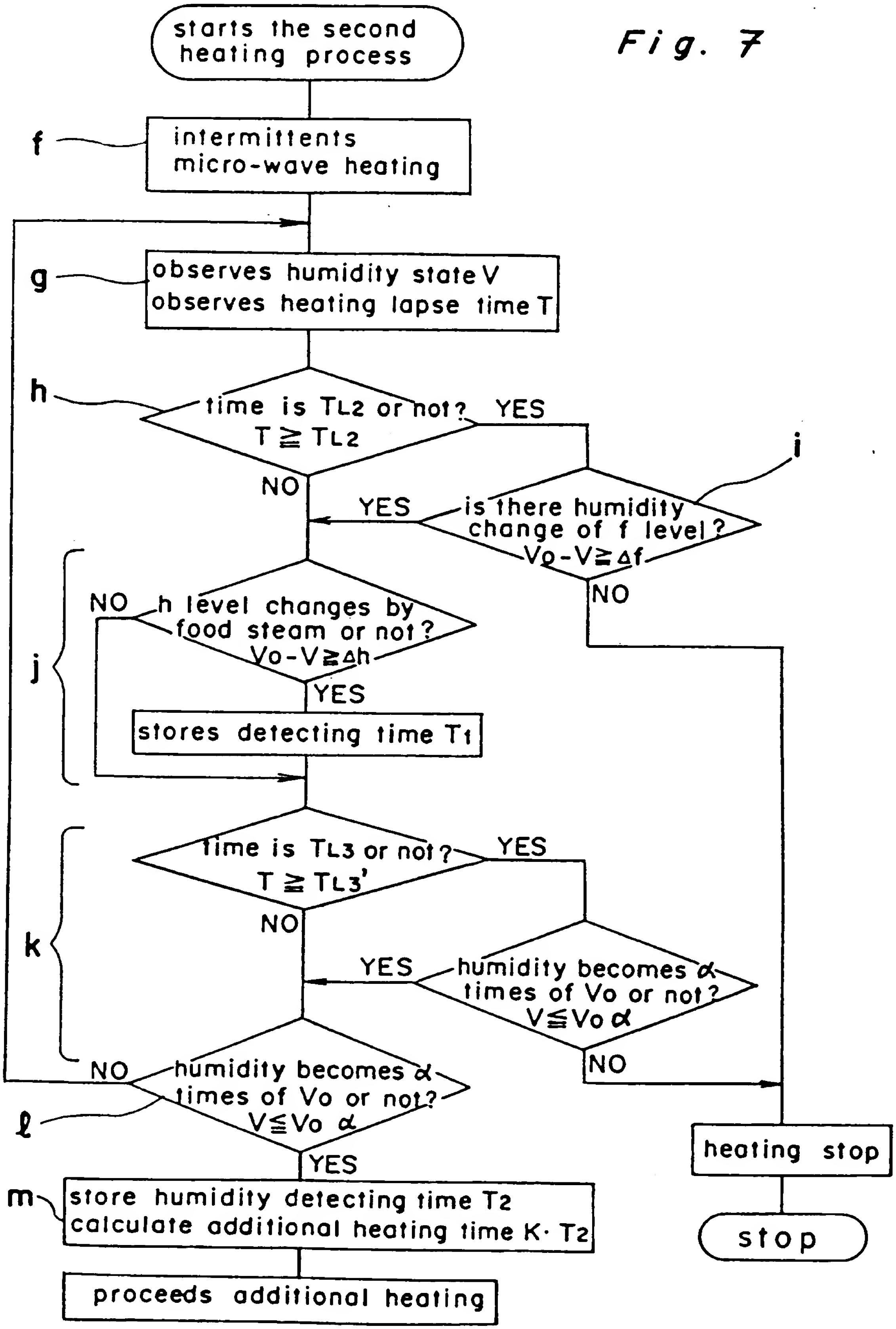

start
begins micro-wave heating
measures food weight W
observes initial humidity state Vo
a
calculates food distinguish time Tw
calculates TL1, TL2, TL3 as hueating stop time
observes humidity state V
observes heating lapse time T
b
is there steam chang of g level?
Vo-V≧Δg
YES
NO
time is TL1 or not ?
T≧TL1
YES
NO
time is Tw or not
T≧Tw
NO
d
YES
c
is ther steam change of g level?
Vo-V≧Δg
YES
NO
time is TL1 or not ?
T≧TL1
YES
NO
h level changes by food steam or not?
Vo-V≧Δh
NO
YES
stores detecting time T1
proceeds the first heating process
e
proceeds the second heating process
heating stop
stop

Fig. 7


starts the second heating process
f
intermittents micro-wave heating
g
observes humidity state V
observes heating lapse time T
h
time is TL2 or not?
T ≧ TL2
YES
NO
i
is there humidity change of f level?
Vo-V ≧ Δf
YES
NO
j
h level changes by food steam or not?
Vo-V ≧ Δh
NO
YES
stores detecting time T1
k
time is TL3 or not?
T ≧ TL3'
YES
NO
humidity becomes α times of Vo or not?
V ≦ Vo α
YES
NO
ℓ
humidity becomes α times of Vo or not?
V ≦ Vo α
NO
YES
m
store humidity detecting time T2
calculate additional heating time K · T2
proceeds additional heating
heating stop
stop